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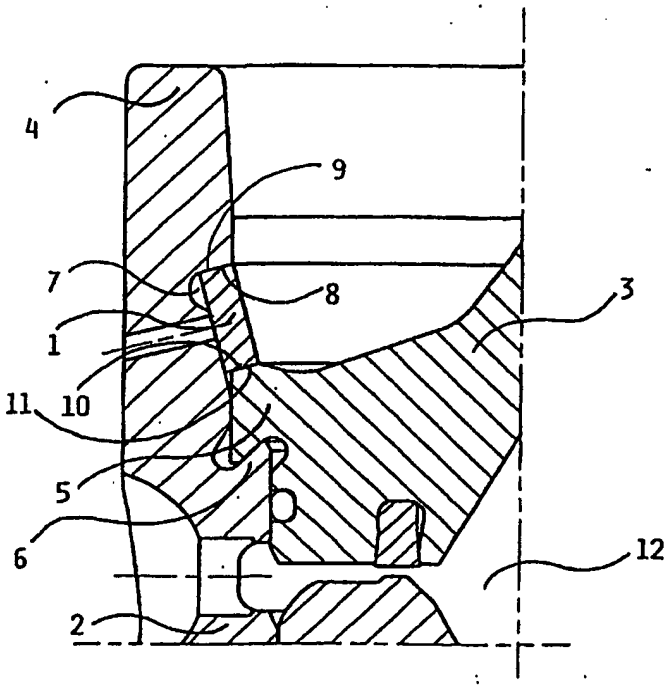
(57) Abstract

A locking ring (1) for joining a first and a second part (2, 3, respectively) of a rotor in a centrifugal separator, the first rotor part (2) having a circular cylindrical end portion (4), which has a certain inner radius and a centre line, which essentially coincides with the rotational axis, and the second part (3) has an annular flange portion (5). The locking ring (1) is arranged to be brought radially outwardly from a position radially inside the inside of the circular cylindrical end portion (4) and axially outside the annular flange portion (5) into a recess (7) and via two radially outer contact surfaces (8, 9) to abut against the end portion (4) and via inner contact surfaces (10, 11) to abut against the flange portion (5). According to the invention the locking ring (1) extends substantially a complete revolution around the rotational axis with two end surfaces turned towards one another and being so formed in one single integrated piece out of an elastically resilient material that it in unloaded condition tends to be substantially annular shaped with an outer diameter, which is at least as large as the outer radius of the recess (7), and that the contact surfaces (8, 9, 10, 11) are so located and directed that they in every axial section around the rotational axis have a middle point, in which the contact surfaces (8, 9, 10, 11) have a direction of normalcy, which is the same and coinciding for all the contact surfaces (8, 9, 10, 11), and in direction towards the separation chamber (12) in the interior of the rotor forms an acute angle with the rotational axis, the contact surfaces (8, 9, 10, 11) being substantially symmetrical with respect to this direction of normalcy.



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Locking ring for a centrifugal separator

The present invention concerns a locking ring for joining a first and a second part of a rotor in a centrifugal separator, which rotor is arranged to rotate around a rotational axis and delimits within itself a separation chamber. The first rotor part has a circular cylindrical end portion, which has a certain inner radius and a centre line, which essentially coincides with the rotational axis. The second part has an annular flange portion, which extends around the rotational axis in a plane perpendicular to the rotational axis. The flange portion has an outer radius, which substantially is as large as the inner radius of the circular cylindrical end portion, the flange portion being insertable in the end portion of the first part in one axial direction against a stop arranged in the rotor and in inserted position being adapted to be lockable in the opposite axial direction by means of a locking joint comprising the locking ring. When assembling the rotor the locking ring is arranged to be brought radially outwardly from a position radially inside the inside of the circular cylindrical end portion and axially outside the annular flange portion into a recess extending around the rotational axis in the inside of the circular cylindrical end portion with a certain outer radius so that a radial outer portion of the locking ring extends out into the recess whereas a remaining radial inner portion of the locking ring extends radially inside the outer radius of the flange portion and so that the outer portion of the locking ring abuts against the circular cylindrical end portion via two radially outer identical contact surfaces and so that the inner portion of the locking ring abuts against the flange portion via two radially inner identical contact surfaces. The contact surfaces are essentially rotational symmetrical around the rotational axis and are adapted to transfer the occurring axial forces due to the liquid pressure in the separation chamber on the second rotor part to the first rotor part.

Rotor parts of centrifugal separators are often joined together by means of screw joints, in which a big locking ring having an external thread surrounding the rotational axis is screw tight in an internal thread of a circular cylindrical portion of the one rotor part.

Above all, locking joints of this kind cause high manufacturing costs and assembling and disassembling costs. Besides, these joints are exposed to heavy loads, which lays high demands on dimensioning, choice of material etc. It might even happen that the material in the threads is exposed to so high loads that the threads seize already during assembling when a certain pre-load shall be established.

In US 4 710 160 another locking joint is disclosed. In this locking joint two or more locking rings of the kind that the present invention concerns are brought radially out into an internal groove in a circular cylindrical portion of the one rotor part. The disclosed locking ring is fixed in the groove and is pre-loaded by means of tightening rings which are screw tight in the other rotor part.

Hereby, it is true that a locking joint is accomplished, which reduces the disadvantages mentioned above. However, the locking joint comprises several details, which shall be manufactured, assembled and occasionally be disassembled and re-assembled. Consequently, also this locking joint causes high manufacturing costs and handling costs.

The object of the present invention is to accomplish a locking ring of the kind mentioned above, by means of which these disadvantages are further reduced without jeopardizing the safety of the locking joint.

According to the present invention this is accomplished by the fact that the locking ring extends substantially a complete revolution around the rotational axis with two end surfaces turned towards one another in the circumferential direction and being so formed in one single integrated piece out of an elastically resilient material that it in unloaded condition tends to be substantially annular shaped with an outer radius, which is at least as large as the outer radius of the recess, and that the contact surfaces are so located and directed that they in every axial section around the rotational axis has a middle point, in which the contact surfaces has a direction of normalcy, which is common and coinciding for all the contact surfaces, and in direction towards the separation chamber in the interior of the rotor forms an acute angle with the rotational axis, the contact surfaces being substantially symmetrical with respect to this direction of normalcy.

Hereby, the resulting force on the locking ring from the first rotor part and the resulting force of equal strength but counter directed from the other rotor part become located just opposite one another in every axial section around the rotational axis resulting in that the locking ring is not exposed to any forces that tend to bring the locking ring out of the recess.

In a preferred embodiment all the contact surfaces are parallel and conical. Preferably the locking ring has a rectangular cross-section.

In another embodiment of the invention the locking ring has such an extension (l) in the circumferential direction and such a radial thickness (t) that the distance in the circumferential direction between the end surfaces in mounted state is less than 3,14 t.

In a variation of this embodiment the locking ring has such an extension in the circumferential direction and such a radial thickness (t) that the distance in the circumferential direction between the end surfaces in mounted state is less than 1,5 t.

In the following the invention is described more closely with reference to the figures on the attached drawings in which

figure 1 schematically shows an axial section through a part of a centrifugal separator, which is provided with one embodiment of a locking ring according to the invention,

figure 2 schematically shows an axial section through a part of a centrifugal separator, which is provided with another embodiment of a locking ring according to the invention, and

figure 3 shows a three dimensional view of a further embodiment of a locking ring according to the invention.

In figure 1 a part of a rotor of a centrifugal separator is shown, which is provided with a locking ring 1 according to the present invention. The rotor rotatable around a not shown rotational axis has a first part 2 and a second part 3. The first part 2 has a circular cylindrical end portion 4, the centre line of which coincides with the rotational axis. The second part 3 has an annular flange portion 5, which extends around the rotational axis in a plane perpendicular to the rotational axis. The circular cylindrical end portion 4 of the first part 2 is then inconsiderably larger than the outer radius of the flange portion 5 so that the flange portion is axially insertable into the end portion 4 against a stop 6 arranged in the first part 2 of the rotor. The inside of the end portion is designed with a recess 7, which

extends around the rotational axis and has in this embodiment a radial outer conical contact surface 8 with a direction of normalcy, which is directed axially and inclined radially inwardly towards the rotational axis.

The locking ring 1 has frusto-conical shape with a rectangular cross-section and extends essentially a complete revolution around the rotational axis. The locking ring has two end surfaces, which are turned towards one another in the circumferential direction. The locking ring 1 is so formed in one single integrated piece by an elastically resilient material that it in unloaded condition tends to be essentially annular shaped with an outer radius which at least is as large as the outer radius of the recess 7. The locking ring is arranged to be able to be brought from a position radially inside the inside of the end portion 4 radially outwardly into the recess 7 when the second part 3 of the rotor has been brought axially towards the stop 6.

In order to make this possible one end of the locking ring 1 can be bent radially inwardly and brought pass the other axial end of the locking ring in the circumferential direction so that the locking ring obtains an outer radius which is less than the inner radius of the end portion 4. To prevent this for certain from happening during operation the locking ring 1 has such an extension in the circumferential direction and such a radial thickness (t) that the distance in the circumferential direction between the end surfaces in assembled condition is less than 3,14 t, preferably is this distance less than 1,5 t.

The recess 7 has such an outer radius that the locking ring 1 when it is mounted in the recess 7 extends out into the recess 7 with a radially outer portion thereof whereas the remaining radially inner part of the locking ring 1 extends radially inside the outer radius of the flange portion 5. The

locking ring 1 then abuts with a radially outer conical contact surface 9 against the outer conical contact surface 8 in the recess 7 and with a radially inner conical contact surface 10, which abuts against a conical contact surface 11 of the annular flange portion 5.

The contact surfaces 8, 9, 10 and 11 are so located and directed that they in each axial section around the rotational axis each has a middle point, in which the contact surfaces 8, 9, 10 and 11 have a direction of normalcy, which for all the contact surfaces 8, 9, 10 and 11 is common and coinciding, and which in direction towards the separation chamber 12 in the interior of the rotor forms an acute angle with the rotational axis, the contact surfaces 8, 9, 10 and 11 being substantially symmetrical around this direction of normalcy.

The embodiment of a locking ring according to the present invention shown in figure 2 differs from the embodiment shown in figure 1 in that the contact surfaces 13, 14, 15 and 16 in an axial section has a curved, preferably circular, shape.

In figure 3 a further embodiment of a locking ring according to the invention is shown three dimensionally, which has a bevelled inner edge 17 at its radially outer contact surface 18, which is arranged to abut against the contact surface of the recess.

In order to polar guide the locking ring 1 a thin projection can be arranged in the recess extending axially and radially between the two end surfaces of the locking ring 1. Alternatively, the locking ring can be provided with a staff formed element on its outside arranged to be brought in a corresponding hole in the recess 7.

Claims

1. A locking ring (1) for joining a first and a second part (2 and 3, respectively) of a rotor in a centrifugal separator, which rotor is arranged to rotate around a rotational axis and delimits within itself a separation chamber (12), the first rotor part (2) having a circular cylindrical end portion (4), which has a certain inner radius and a centre line, which essentially coincides with the rotational axis, and the second part (3) having an annular flange portion (5), which extends around the rotational axis in a plane perpendicular to the rotational axis and which has an outer radius, which substantially is as large as the inner radius of the circular cylindrical end portion (4), the flange portion being insertable in the end portion (4) of the first part in one axial direction against a stop (6) arranged in the rotor and in inserted position being adapted to be lockable in the opposite axial direction by means of a locking joint comprising the locking ring (1), which when assembling the rotor is arranged to be brought radially outwardly from a position radially inside the inside of the circular cylindrical end portion (4) and axially outside the annular flange portion (5) into a recess (7) extending around the rotational axis in the inside of the circular cylindrical end portion (4) with a certain outer radius so that a radial outer portion of the locking ring (1) extends out into the recess (7) whereas a remaining radial inner portion of the locking ring (1) extends radially inside the outer radius of the flange portion (5) and so that the outer portion of the locking ring (1) abuts against the circular cylindrical end portion (4) via two radially outer identical contact surfaces (8, 9, 13, 14) and so that inner portion of the locking ring (1) abuts against the flange portion (5) via two radially inner identical contact surfaces (10, 11, 15, 16), which contact surfaces (8, 9, 10, 11, 13, 14, 15, 16) are essentially rotational symmetrical around the rotational axis and are adapted to transfer the occurring axial forces due to the liquid pressure in

the separation chamber (12) on the second rotor part (3) to the first rotor part (2),

characterised in

- that the locking ring (1) extends substantially a complete revolution around the rotational axis with two end surfaces turned towards one another in the circumferential direction and being so formed in one single integrated piece out of an elastically resilient material that it in unloaded condition tends to be substantially annular shaped with an outer diameter, which is at least as large as the outer radius of the recess (7), and

- that the contact surfaces are so located and directed that they in every axial section around the rotational axis have a middle point, in which the contact surfaces (8, 9, 10, 11, 13, 14, 15, 16) have a direction of normalcy, which is common and coinciding for all the contact surfaces (8, 9, 10, 11, 13, 14, 15, 16), and in direction towards the separation chamber (12) in the interior of the rotor forms an acute angle with the rotational axis, the contact surfaces (8, 9, 10, 11, 13, 14, 15, 16) being substantially symmetrical with respect to this direction of normalcy.

2. A locking ring according to claim 1, characterised in that all the contact surfaces (8, 9, 10, 11, 13, 14, 15, 16) are parallel and conical.

3. A locking ring according to claim 2, characterised in that it in an axial section has a rectangular cross-section.

4. Locking ring according to any of the claims 1-3, characterised in that it has such an extension in the circumferential direction and such a radial thickness (t) that the distance in the circumferential direction between the end surfaces in mounted state is less than 3,14 t.

5. A locking ring according to claim 4, characterised in that it has such an extension in the circumferential direction and such a radial thickness (t) that the distance in the circumferential direction between the end surfaces in mounted state is less than 1,5 t.

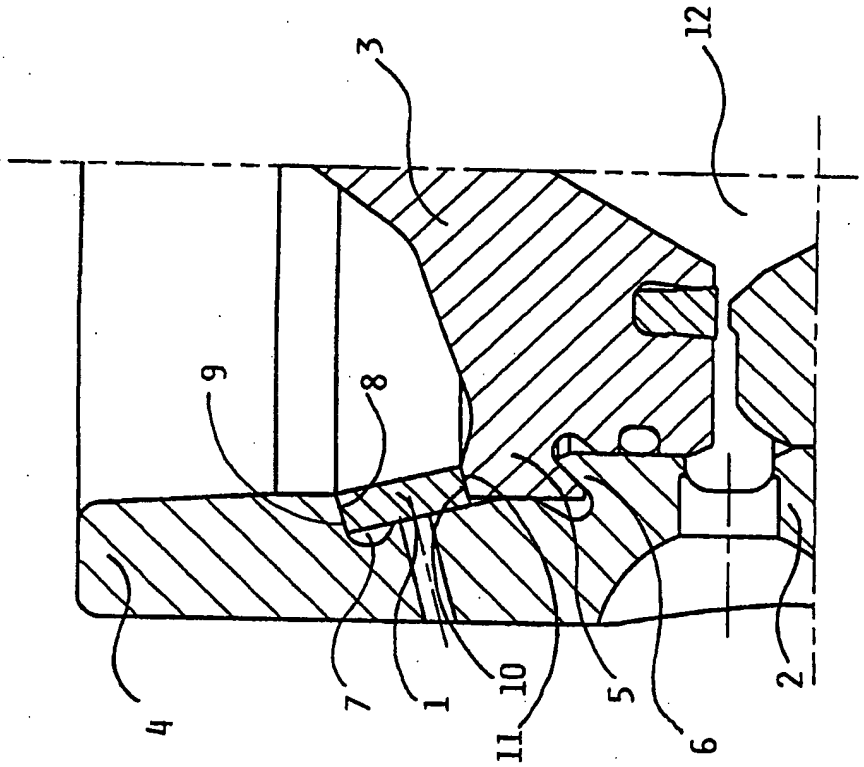

Fig. 1

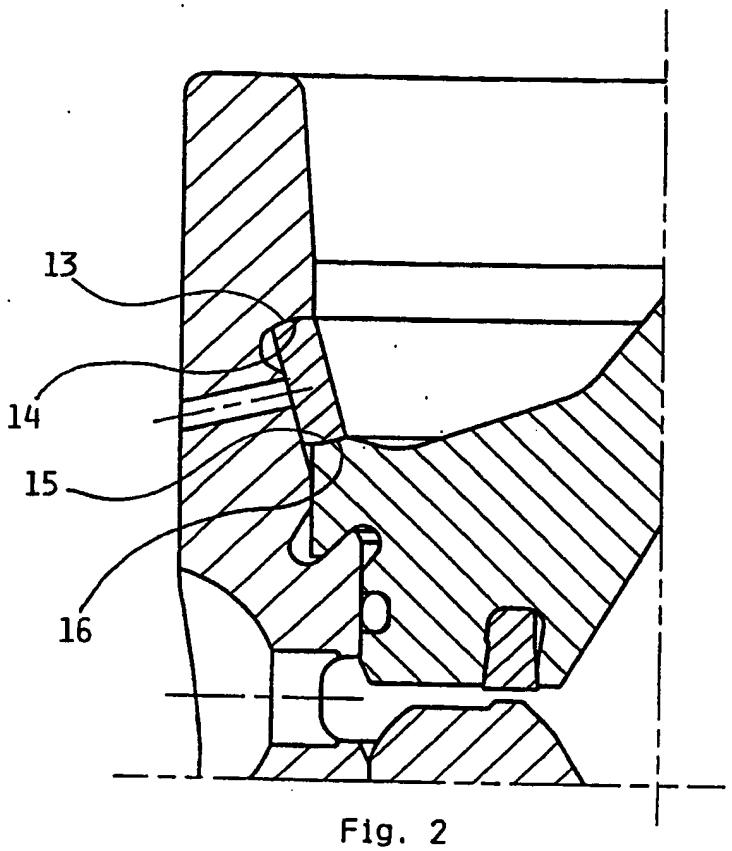

Fig. 2

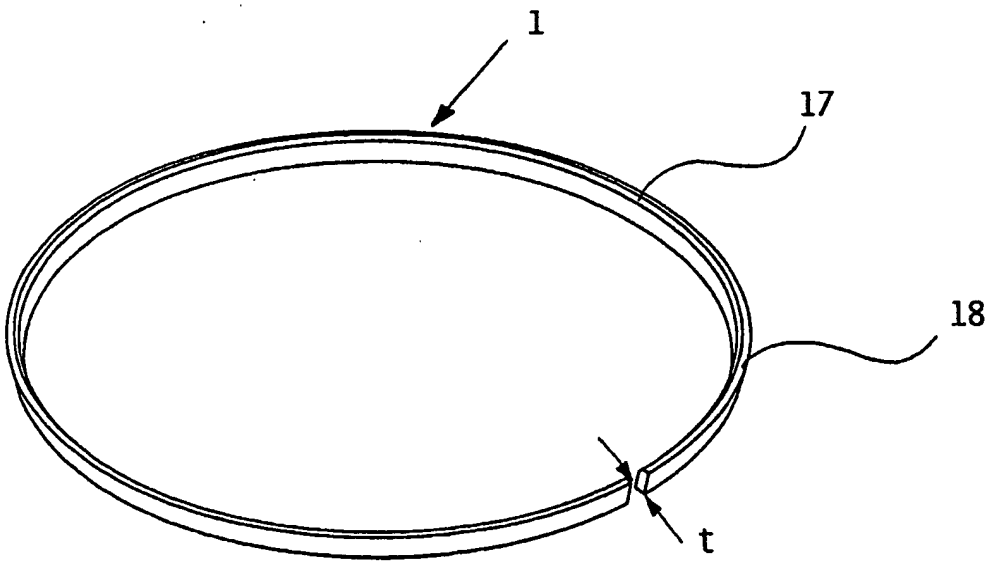

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4710160 A (KLINTENSTEDT ET AL), 1 December 1987 (01.12.87), figures 1-3 --	1
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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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